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ACTIVITIES OF THE DIVISION OF SCIENCE TEACHING OF UNESCO. PAPER PRESENTED AT THE AAAS MEETING, DECEMBER 26, 1967, NEW YORK.

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A PAPER PRESENTED TO THE SECTION ON EDUCATION (Q) OF THE 1967 AMERICAN ASSOCIATION OF SCIENCE ANNUAL CONVENTION, THIS DOCUMENT DISCUSSES THE ACTIVITIES OF THE DIVISION OF SCIENCE TEACHING (DST) OF UNESCO. INCLUDED ARE DISCUSSIONS OF (1) THE OVERALL PROGRAM BUDGET, (2) AN HISTORICAL PERSPECTIVE OF THE DEVELOPMENT OF DST AND ITS RELATIONSHIP TO THE EDUCATION SECTOR OF UNESCO, AND (3) A DESCRIPTION OF THE PRESENT OVERALL PROGRAM AND PROJECTIONS FOR THE FUTURE. THE PRESENT PROGRAM IS DESCRIBED UNDER ITS FOUR MAIN PARTS (1) COLLECTION AND EXCHANGE OF INFORMATION, (2) PILOT PROJECTS ON NEW APPROACHES AND MATERIALS FOR THE TEACHING OF BASIC SCIENCES, (3) OTHER ACTIVITIES TO IMPROVE THE TEACHING OF THE BASIC SCIENCES AT UNIVERSITY AND POST-GRADUATE LEVELS, AND (4) STIMULATION OF INTEREST IN SCIENCE. SPECIFIC PROJECTS AND PROGRAMS BEING CARRIED OUT UNDER EACH OF THE FOUR MAIN PARTS ARE DISCUSSED AND THE PRIMARY GEOGRAPHIC AREAS AFFECTED ARE INDICATED. A BIBLIOGRAPHY FOR THE PROVISION OF MORE DETAILED INFORMATION IS INCLUDED. (DS)

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1. The Role of Science in UNESCO

UNESCO is the permanent specialized agency of the United Nations whose purpose is to contribute to international peace and security through education, science and culture. It depends on over 120 member governments both for its regular program budget - currently running about 63 million dollars per biennium - and for approval of its policies.(1) It celebrated its 20th anniversary last year, two years after affirming at its General Conference that science would be given equal emphasis with education and culture in its program.(2)

Considering the fact that UNESCO is only 21 years old - a vanishingly small fraction of the total time mankind has struggled along without the benefit of truly international organizations - it is not surprising that its peaceful aims are as yet to be achieved. In these 21 years, however, UNESCO has at least learned how to handle the difficult task of providing assistance in science and technology to its less developed Member States. This has been possible primarily through the support provided by the Technical Assistance (TA)

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and Special Fund (SF) projects of the United Nations Development Program (UNDP) which make available approximately another 63 million dollars to Member States through UNESCO bringing the total available funds to about 126 million dollars per biennium. The fact that there are two parts to UNESCO's program is worth repeating. The first, called its "regular program" consists of activities planned and administered by the Secretariat with its own budget in answer to the will of the Member States. The second consists mainly of national projects financed by the TA and SF programs, administered by UNESCO, utilizing funds which individual Member States have requested and obtained from UNDP. This money goes into experts, fellowships and equipment usually to strengthen existing institutions or to build new ones.

2. Science Education in UNESCO - the Role of the Division of Science Teaching

We are going to describe the activities of a single division of UNESCO, the Division of Science Teaching (DST), responsible for approximately one per cent of the total program of UNESCO. Its yearly regular program budget is roughly $625,000 per biennium. Divided equally among its 120 Member States this would provide each with $2600 per year, a sum which would not even pay the full cost of a one-year scholarship let alone purchase a sophisticated piece of apparatus for scientific research. This makes it abundantly clear that DST must concentrate its limited resources into key activities in selected regions of the world. It must, in fact, capitalize on its ability to catalyze and internationalize activities that have an inherent multiplier effect. It has chosen to do this, as we shall soon explain, in experimental activities that can point to new directions for all of UNESCO's science education projects.

The organizational units of UNESCO are the sector, the department and the division, in order of decreasing size. The sectors are those of education, science and culture. Within each there are several departments. In the science sector, for example, there are (i) the Department for the Advancement of Science (AVS) and (ii) the Department for the Application of Science (APS). The Division of Science Teaching (DST) is within AVS along with divisions for oceanography, natural resources and research and documentation. That is as far as we will go in giving a breakdown. The departments and divisions in the other sectors are at present in a state of flux and any description of them given now might not be valid six months from now. The budget of DST is about ten percent of that of the whole science sector and, as we said earlier, about one percent of UNESCO's total budget.

It is apparent from its title that DST deals with both science and education. There are valid arguments to support its presence in either of these two sectors. The fact that it sits in the science sector reflects the resultant of several forces tending to pull it in different directions. Six years ago the Division of Science Teaching was formed on the initiative of officers in the science sector. Its regular program budget was $38,000 in 1961-1963 (and $184,000, $570,000, $627,000 in subsequent biennia - whose uneven plot reflects something of the internal drama of UNESCO) and it had a professional staff of two. In 1969-1970 it will probably have a staff of 9 professionals and a regular program budget of $808,000 with approximately an equal amount from UNDP. Strong pressures have at various times been exerted to move DST to the education sector but, obviously, stronger pressures have prevailed to keep it within the science sector until now. The Director General has indicated that UNESCO may undertake a science education program in 1969-1970 "comparable

in magnitude with that of the literacy campaign" but has not yet specified whether DST will remain in AVS nor whether DST will generate the houswide policy needed to coordinate and integrate an expanded program. Recent decisions have, in principle, placed responsibility for an integrated science teaching policy in the hands of DST but in practice they have not been sufficiently explicit about implementation of this mandate to make them effective.

When DST was created in 1961 a convenient but artificial dividing line had been drawn within UNESCO based upon the fiction that university activities in science education could be separated, both administratively and intellectually, from those at the secondary school and lower levels. The Division of Science Teaching was asked to concern itself only with science teaching at the university and post graduate levels while the education sector was to deal with science education at the level of the secondary school and lower. This provided a neat administrative separation but did not make sense from the intellectual point of view because of the continuity in content which science possesses at all levels. It also did not take into account a very significant change that was taking place in some of the advanced countries at that very moment. For the first time in history scholars in the field of science and professional scientists in universities and research institutions were beginning to shed their traditional apathy toward science education and were participating in the most vigorous activity for course improvement and curriculum reform in science that had ever taken place. They were getting adequate financial support from government agencies and were tackling these activities in the same spirit and with the same enthusiasm that they had once given to research in pure science. By doing so they breathed new life into old pedagogical practices and actually spearheaded reform in other fields.

The Division of Science Teaching of UNESCO was created during this time of ferment and it attracted some of the scientists who had been involved in the reform movement. They developed the division along lines consonant with the prevalent spirit of reform. The division evolved a program that was guided by scientists, both inside and outside the Secretariat, and that was strongly oriented toward the development of new approaches, methods, techniques and materials in science teaching. It now has two university level scientists in each of the basic sciences - physics, chemistry, biology and in mathematics. As scientists, they felt at home in the environment of the science sector of UNESCO where all professional staff members are either scientists or engineers.

An important difference between science, on the one hand, and education or culture on the other becomes apparent if one considers the specialised nature of the professional training needed to become a scientist. An academic degree equivalent to that of the doctor of philosophy and original research published in scholarly journals are usually the minimum professional requirements for a scientist. In education and culture, on the other hand, such definite professional criteria do not exist for many of their activities. Education and culture are very broad. They range over all possible academic levels and activity in these fields sometimes does not depend upon academic qualifications at all. There is, therefore, an understandable disparity between the professional qualifications for posts in the science sector and those in other sectors of UNESCO. It was easier to attract scientists with an interest in course improvement and curriculum reform into the science sector. Administrative ability is required in all sectors but in science teaching it is also important to have a thorough grasp of subject matter in at least one field of science.

The new scientists in the Division of Science Teaching brought with them the advantage of the new enthusiasms born of experimental activities in course improvement and curriculum reform in their countries, but they had to learn what their counterparts in other sectors of UNESCO had picked up over the years - namely- administrative experience developed in the course of implementing educational programs in the Member States for almost twenty years.

Space does not permit us to relate the interesting story of how communication and rapport between the education and science sectors was slowly established, at least at the working level, so that the artificial barriers separating secondary and university levels of science were in many cases surmounted.

We must proceed instead to describe the work of DST but first a very significant fact must be underlined: the budget for the programs in science teaching administered by the education sector is about 20 times larger than that administered by DST. UNICEF and UNDP (Technical Assistance and Special Fund) have heavy investments in UNESCO science teaching field projects administered by the education sector. UNESCO has, for example, established with Special Fund support about twenty teacher training colleges in Africa. Each such project received between one and five million dollars from UNDP to be matched by the recipient country. Each college has a strong science compoennt. The Total UNDP support to science education projects such as these will be about $20 million for this biennium. As another example, the education sector has been assisting secondary schools with UNICEF support to purchase equipment to train primary school teachers in science. The budget for this alone will exceed $4 million in the present biennium. The key words to associate with these education sector activities are implementation and impact.

The large impact of UNESCO's program in science education is generated by these projects. They are implemented by the education sector of UNESCO which, incidentally, has few if any scientists on its Secretariat staff at any given time. By comparison, the relatively small program of the Division of Science Teaching of the science sector is characterized by the words <u>experimentation</u> and <u>improvement</u>. Each staff member of the division is a specialist in one of the basic sciences. He executes a program, principally from regular program funds, in his subject field, devoted to research and development on new approaches, methods, techniques and materials for teaching and learning. The Pilot Projects are perhaps the best examples of this kind of exploratory and demonstration work. These projects develop, with the help of talented people within the region, guidelines and resource materials to demonstrate what can be done when the means are found to carry out the large <u>impact</u> job. DST is concerned about raising the quality of instruction and learning. The link between DST and the education sector is obvious. It must supply the guidelines and assistance which only a group of specialists can generate in experimental programs and feed them to the impact programs of the education sector. DST assists these programs by recruiting science education experts, briefing them in a demonstration science teaching laboratory at headquarters and collecting documents and apparatus which can help them keep abreast of the rapidly changing scene in science education. DST is now also being asked to visit the major science teaching projects of the education sector in the field and to make recommendations to their administrators on what might be done to improve the science teaching aspect of such projects. In the past it was customary to associate the word <u>quantity</u> with the work of the education sector and the word <u>quality</u> with that of DST. A more accurate

set of words to summarize the role of each sector in science education would be impact for the education sector and direction for DST. The first requires excellent administrative ability. The second requires the rare combination of specialized knowledge and interest in teaching in a subject matter field plus administrative ability.

3. The Program and Budget of the Division of Science Teaching.

The program of the Division of Science Teaching which we have associated with experimentation and improvement has four main parts. The budgets cited are those for 1967-1968 under Regular Program (RP), Technical Assistance Program (TA), and Special Fund Program (SF).

(i) Collection and Exchange of Information ($84,000 RP)
DST will publish, on a terminal basis, in English and in French, 5 separate volumes entitled "Surveys" on teaching of physics, chemistry, biology, mathematics and geology at university level in six advanced countries (UK, USSR, USA, France, Germany, Czechoslovakia). DST will also publish 4 separate volumes, on a continuing basis, during each biennium entitled "New Trends" in the teaching of physics, chemistry, biology and mathematics for teachers and teacher trainers.
As part of its program to exchange modern information DST will perform subject matter briefings of science teaching experts, on a housewide basis, going out to field posts and will maintain a demonstration center containing documents and equipment for that purpose.

(11) Pilot Projects on New Approaches and Materials for the Teaching of the Basic Sciences ($397,000 RP, $276,310 TA)
The first such project started as a one year activity - now called the International Working Group (IWG) - in Sao Paulo, Brazil. Twenty professors of physics came from eight Latin American countries to participate in a joint project of experimentation and development on new materials for the teaching of a selected portion of a course - the physics of light. They came from colleges and universities where future secondary school teachers are trained. They produced 5 books in programmed instruction form, combining the elements of textbook and laboratory guide, 8 kits of inexpensive laboratory materials, 11 short film loops for a cartridge-loaded projector, one long sound film, a teachers guide for the films and a book with the scripts of 8 TV teaching programs which they had produced for transmission over a Sao Paulo TV station. All of this was the "take-home pay" for each participant. It had been produced by an intensive 20 man-year effort by Latin Americans for Latin America. UNESCO supplied the experts and the materials at a cost of $140,000. This also included the cost of a 4-week seminar at the end with participants from 15 countries for demonstration, testing and evaluation(3). The pattern of execution for subsequent projects has changed slightly but the general objectives of experimentation, development and demonstration have remained. Now the projects are prepared for in advance of the IWG by the formation of permanent National Study Groups in the countries of the region. (There are over 20 Study Groups for the biology project in Africa, for example.) These groups are provided with materials

from the curriculum reform groups in the advanced countries for study, in preparation for the IWG and to stimulate and inform even those members of the Study Groups who will not have a chance to attend the IWG. Preparatory seminars are now held before the IWG and evaluation and demonstration seminars are held after the IWG. Reinforcement of the IWG center and/or the Study Groups with Technical Assistance support is already assisting (e.g. in the chemistry Pilot Project in Asia[4]) in the formation of national centers for science teaching improvement with may, in some cases, become permanent institutions[5] for this purpose, possibly with support from the Special Fund of UNDP. We list the projects in chronological order giving dates only for the IWG but it bears repeating that long range planned activities now precede and follow the IWG.

(a) Physics in Latin America, IWG 1963-1964

(b) Chemistry in Asia, IWG 1965-1966

(c) Biology in Africa, IWG 1967-1968 Eng ish, 1969-1970 French.

(d) Mathematics in the Arab States, IWG 1969-1970, English and Arabic; 1971-1972, French and Arabic.

In retrospect it has been realized that these projects have served to demonstrate the feasibility of course improvement and curriculum reform. They have shown that new approaches and materials can be developed locally, often inexpensively, suited to local needs, by local scientists and teachers with support from an international team of experts. They have, in short, been <u>experimental</u> projects that have produced resource materials and pointed to <u>new</u> <u>directions</u>. The resulting resource materials are now slowly being introduced into the larger <u>impact</u> programs of the education sector.

The above prjects have utilized university scientists to produce resource materials for the secondary schools but a separate pilot project to produce materials for improved teaching at the university level, e.g. in the field of the physics and chemistry of solids, has also been started.(6) Its method of operation is somewhat different from that of the projects cited but it has in common with them the goal of improvement through experimentation and development leading to new approaches, methods and materials for teaching and for learning.

(iii) Other Activities to Improve the Teaching of the Basic Sciences at University and Post-Graduate Levels.

(a) Post-Graduate Training Courses. ($100,000 RP, $185,000 TA)

UNESCO develops and organizes one-year international post-graduate training courses in the basic sciences offered by university, academies of science and similar institutions in the advanced countries for the benefit of scientists, teachers and research workers from the developing countries. The aim of these courses is to help developing Member States to train their high level scientists, primarily for staffing university science departments. Some eight courses per year are in operation during 1967-1968. The host countries normally provide an amount approximately ten times larger than the UNESCO contribution.

(b) Advanced Centres Project in India and Assistance to Other University Science Teaching Projects.

(626,400 TA)

Some centres of advanced studies in science in India have been selected for reinforcement through

Technical Assistance aid. The aim is to make them the acknowledged national centres of excellence in their field. A similar concentrated effort is planned for Pakistan and possibly in other countries. In addition, assistance in the usual form of experts, fellowships, and equipment is being given to colleges and universities on the basis of their individual request.

(c) Faculties of Science. ($266,965 SF)

This is a new type of activity whereby UNESCO assists in the creation or strengthening of the faculty of science of a university with support from the Special Fund. There is at present only one project, in Jordan, but it is expected that this type of activity will expend.

(d) Science Teaching Centres. (SF)

In order to institutionalize the type of research and development activities which began with the Study Groups or the International Working Groups of the Pilot Projects and which are in some cases expanded in one subject alone through Technical Assistance support, the Special Fund has indicated its willingness to consider applications for Science Teaching Improvement Centers(5). Applications have been submitted by Israel and Brazil.

(iv) Stimulation of Interest in Science. ($50,500 RF)

For several biennia there has been a demand at the General Conference for increased activity in what was once called the popularization of science (for which UNESCO has awarded the Kalinga Prize for many years) and which more recently is termed the public understanding of science. The hope has been highest but least articulate in the less developed countries, for a vast program of implantation of

scientific ideas into their non-industrialized societies which might begin through activities such as science clubs and fairs, toys and tools for children, science museums and the like. Terms like "eradication of scientific illiteracy" have caught the fancy of the Member States and they have asked for action in this field. Up to the present UNESCO's response to these demands has been of a token sort. The Division of Science Teaching, already taxed to the limit with in-school programs such as the Pilot Projects, has had neither the staff nor the funds to launch a campaign for scientific literacy. It has, however, utilized university professors and other qualified experts to carry out short-term (1-2 month) missions to universities and other institutions of higher education in developing countries. These visiting scientists delivered lectures on new developments in science and on problems of science education. The missions were usually designed, however, to support existing programs of DST with special emphasis on Pilot Projects and post-graduate training courses. DST has also promoted action in the field of scientific films and has given a small amount of aid to other sectors in the fields of science museums and science clubs and fairs.

Considering the fact that museums and out-of-school education for youth and for adults have special programs in the other sectors of UNESCO, it has been suggested that DST can, in the future, serve this cause by giving technical assistance to these projects rather than expand its own activities in these directions.

4. Conclusion. The Role of Advanced Countries in the International Science Teaching Activities of UNESCO

It is well known that some advanced countries have very strong activities in course improvement and curriculum reform

in the sciences. They receive many requests for help from the less developed countries and have, in several instances, developed aid programmes for this purpose on a bilateral basis. While this may be the most efficient method of proceeding, especially if the purpose is to serve the national interests of the donor country, it is often not the best procedure to follow if the intention is to develop a truly international programme of assistance to the less developed countries. Often not even the national interests are best served in the long run by bilateral programmes because the recipient countries know that aid is being given to them for purposes of national security and react to them accordingly. We propose that the proper mechanism for international exchange of experience in science teaching already exists in UNESCO. It should, of course, be strengthened immediately by channelling more of the present bilateral aid through UNESCO. The mechanism for special appropriations to UNESCO already exists and is widely used by UNESCO divisions other than DST. After due consultation, funds from advanced countries could be "tagged" and given to support special programmes of DST. Widespread assistance (already begun on a small scale) consisting of experts and materials could be given, for example, to each Study Group of the Pilot Projects and to the IWG itself. The advanced countries of Europe would also like to benefit from international experience in course improvement and curriculum reform in science but UNESCO has neglected them while concentrating on the needs of the less developed countries. A fund could be set up from these countries and the USA, for example, to assist UNESCO in running special conferences and other activities on a truly international basis. The teaching commissions of the international scientific unions which, incidentally, are advisers to DST have the technical manpower and the interest to organize international conferences on science education but they have practically no budget. Extra budgetary funds could be allotted to them through UNESCO. The mechanism for accepting such specially allocated funds, we repeat, already exists. It has not yet been used by DST.

More detailed information on the programmes of DST and on the advisory role played by the teaching commissions of the international

unions is available from UNESCO[7]. A report[8] entitled Improving Science Education recently submitted to the Advisory Committee on Science and Technology of the U.N. has some further suggestions for future international action, through UNESCO, in science education.

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